

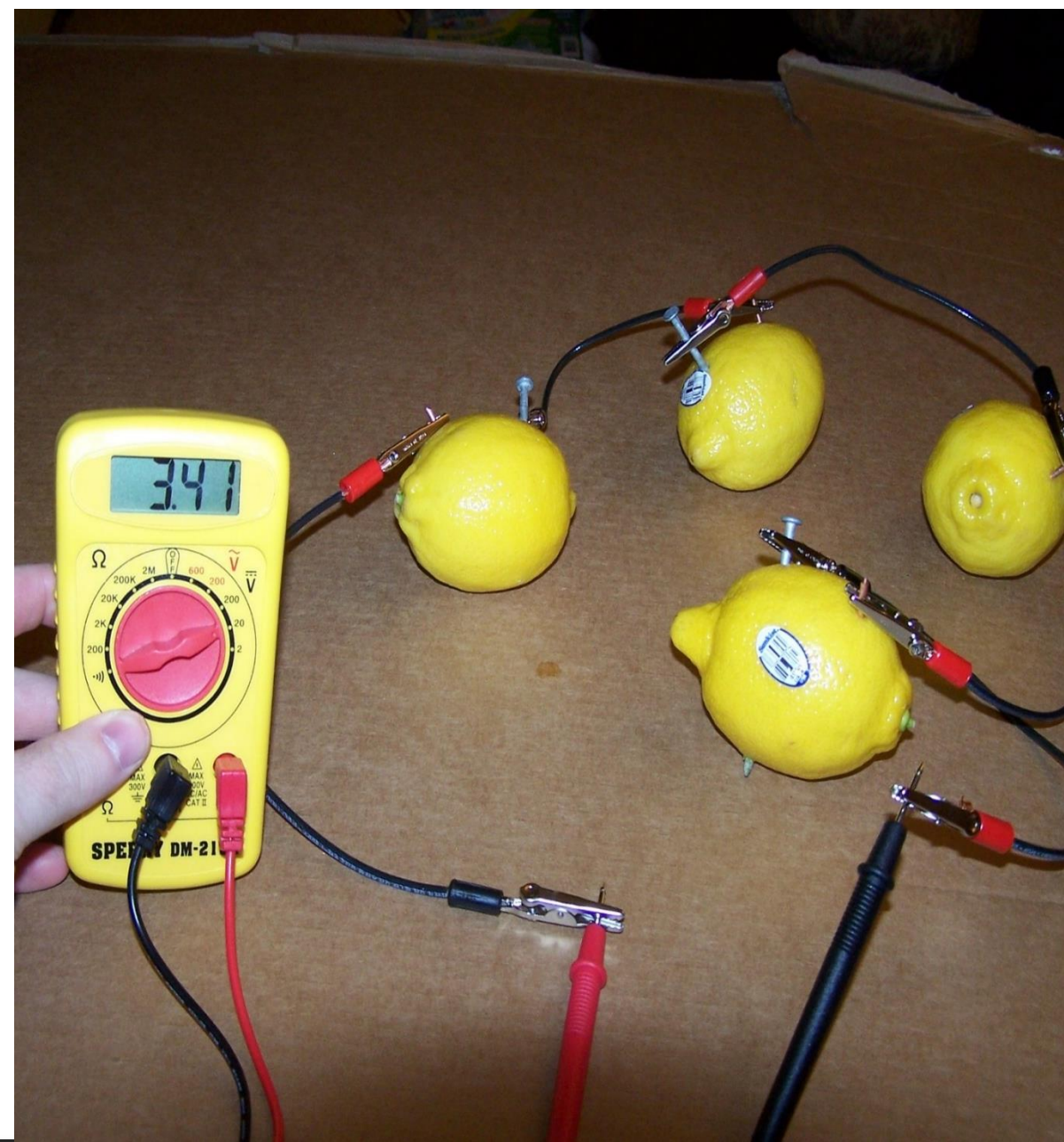
Power Tuning Linux: A Case Study

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<http://01.org/powerTOP>

About Experiment



About Experiment

Software

- Ubuntu 13.10: Includes Ubuntu Linux Kernel 3.11.0-12.19. Based on upstream Linux Kernel 3.11.13, upstream Linux Kernel 3.13.7, and 3.14.0.

Hardware

- *Microsoft Surface Pro 3*
 - 12-inch 2160 x 1440
 - 1.9 GHz Intel Core i5 4300U – Haswell-ULT
 - 256 GB SSD Hard Drive
 - Battery life: 5 Hours 30 minutes
- *Sony VAIO Pro 13*
 - 1920 x 1080 touch screen LCD
 - Intel Inside Core i5 4200U @ 1.60 GHz – Haswell-ULT
 - 128 GB SSD drive
 - Battery life: 6 Hours 30 minutes <http://laptops-and-notebooks.findthebest.com//2085/VAIO-Pro-SVP13213CXB>

About Experiment (cont.)

HW Tools:

- Yokogawa WT310
- Photometer

SW Tools

- PowerTOP

Other Hardware

- USB drive
- USB mouse
- SD Card

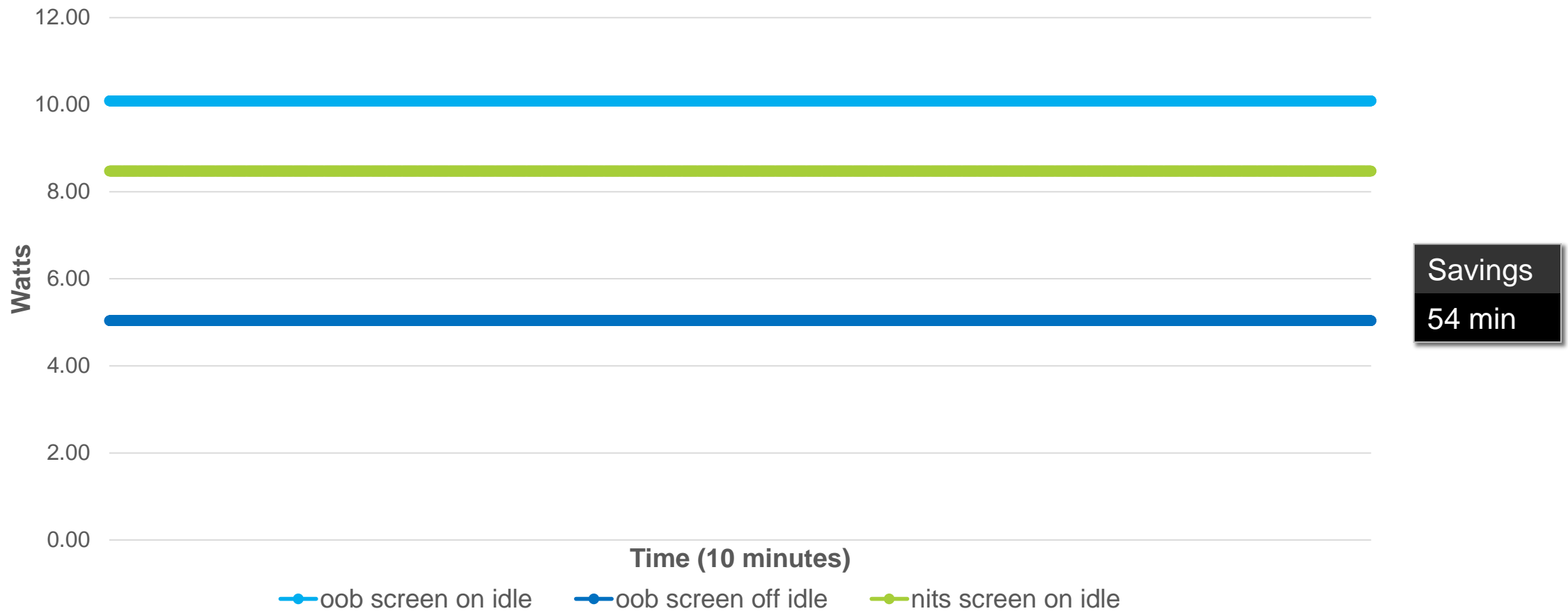
• Tests:

- 10 minutes intervals.
- Wall Power.
- Suspend PM.
- Idle Power Management (PM).
- Battery fully charged

The Results

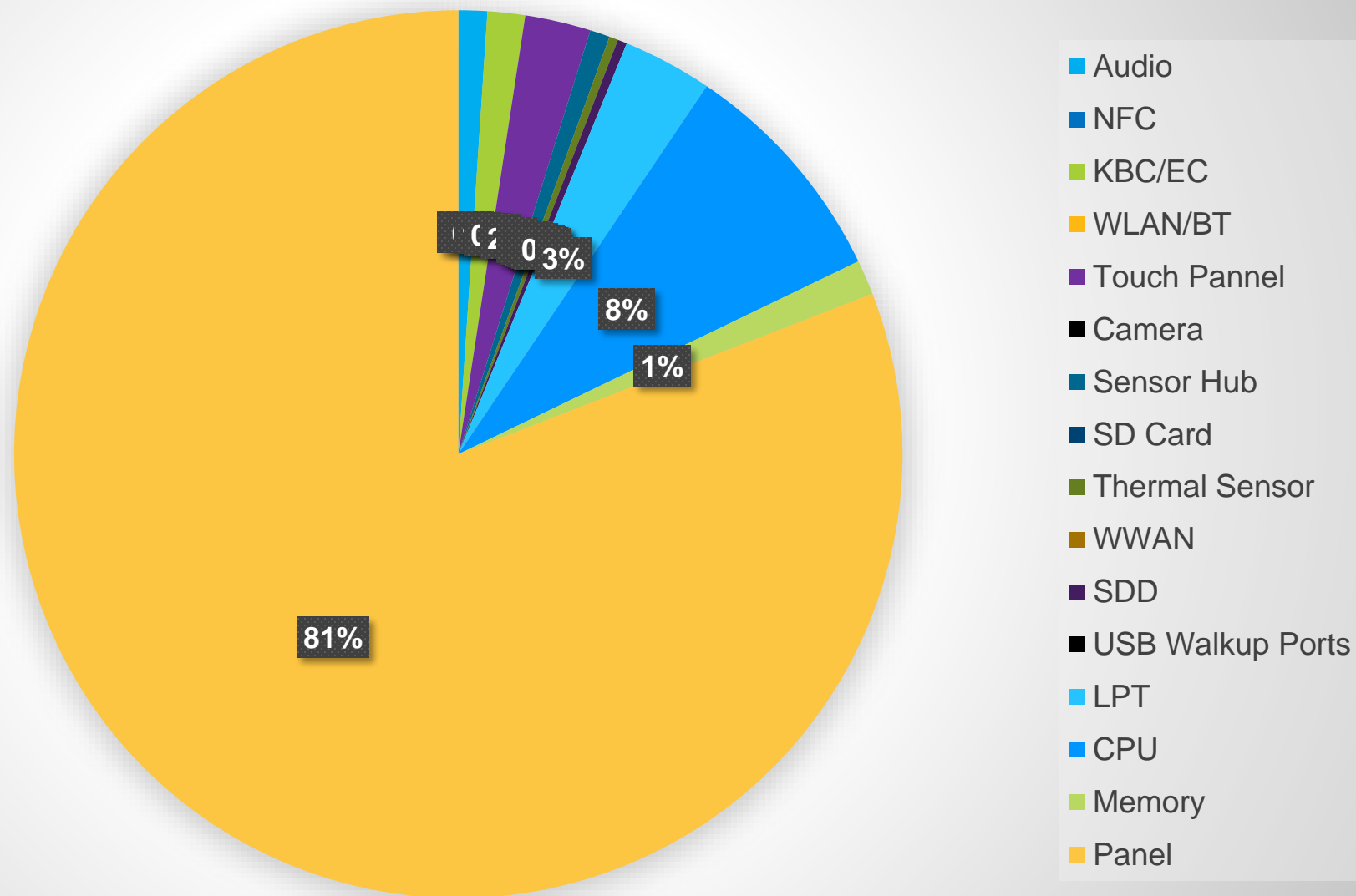


Out of the Box (OoB) Ubuntu 3.16.0



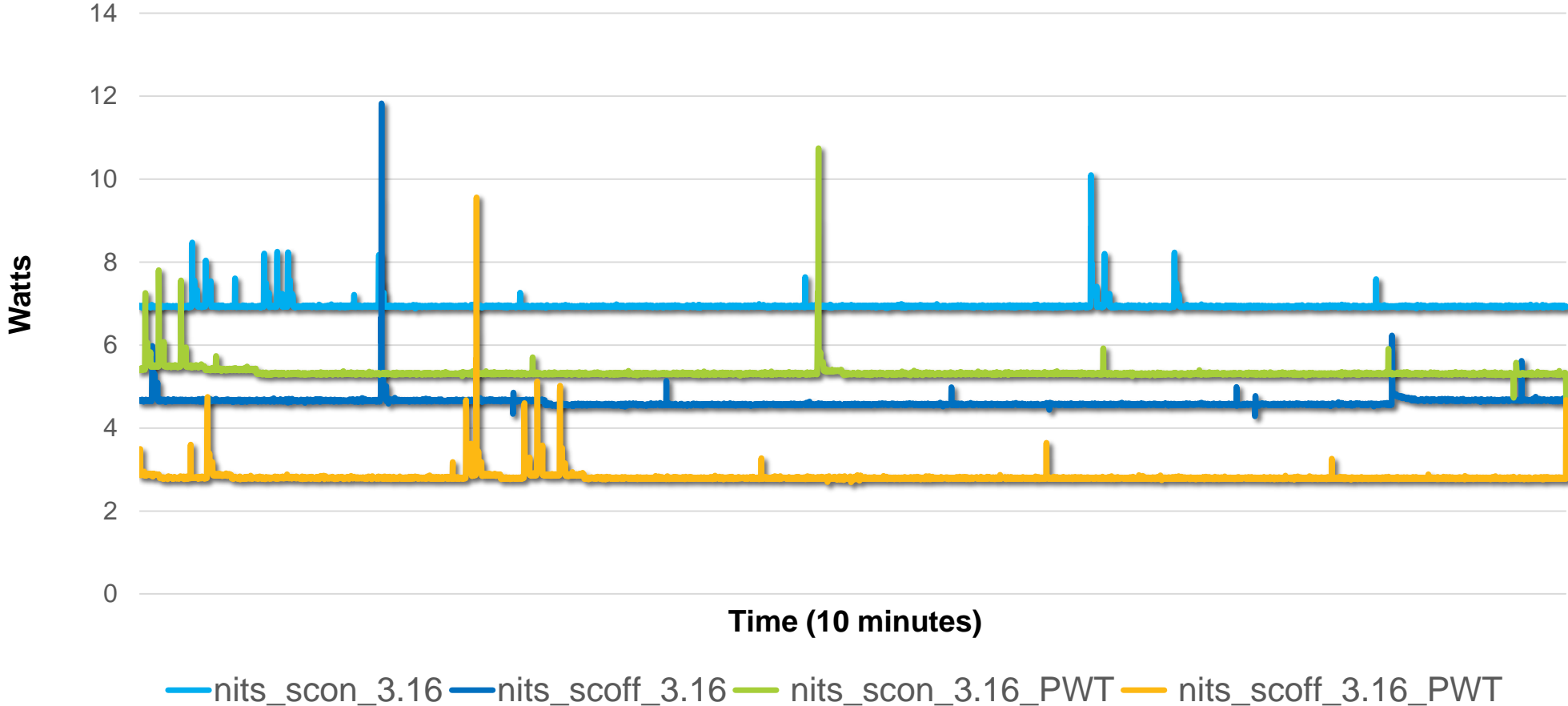
```
// change Nits. Number may change according to hardware  
$echo 515 > /sys/class/backlight/intel_back/brightness
```

Overall Platform Power Consumption



Linux Kernel 3.16

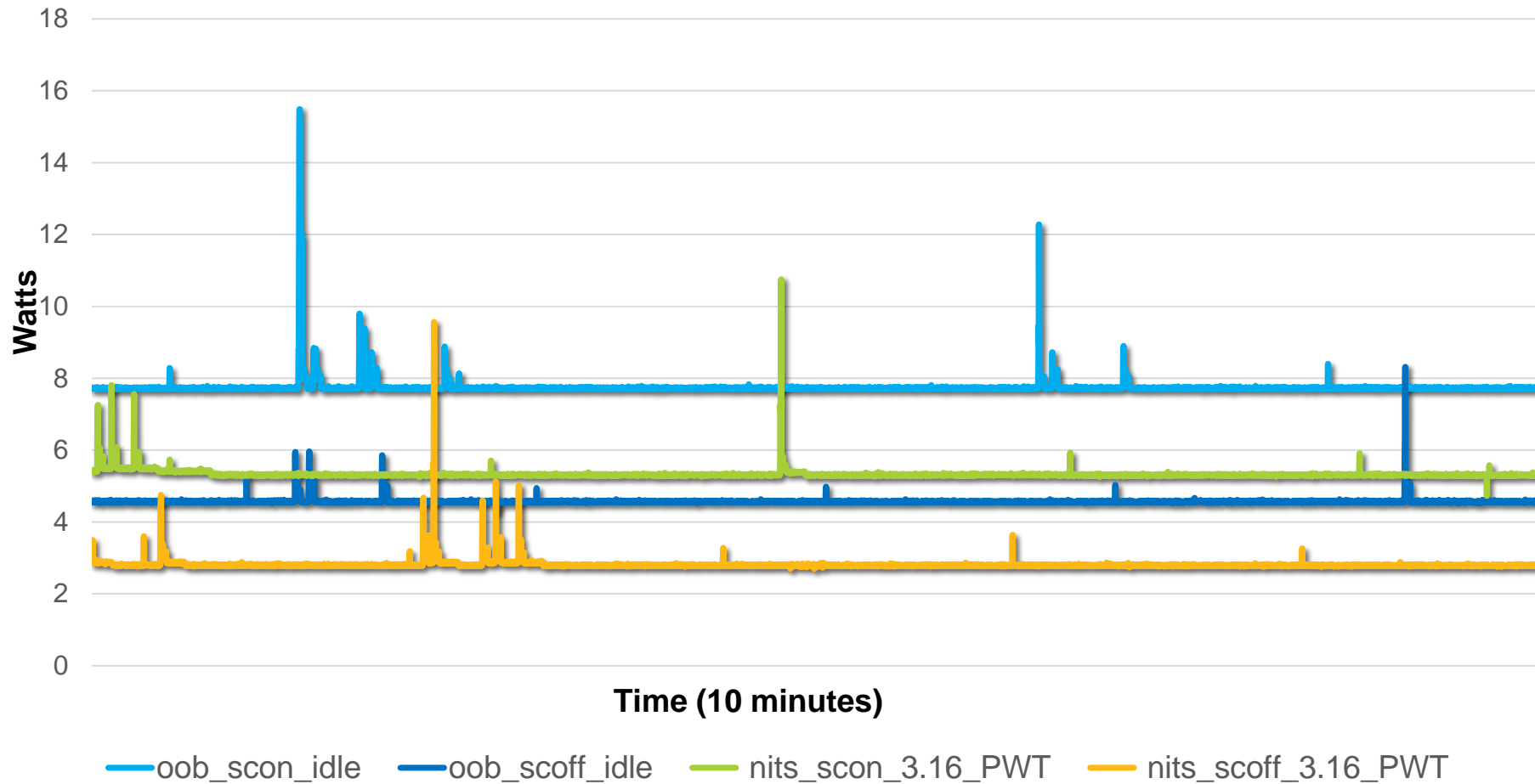
Linux Kernel 3.16 & PowerTOP



| Savings (hh:mm) | |
|-----------------|------|
| SC_ON | 1:45 |
| SC_Off | 3:00 |

Out of the box vs Linux Kernel 3.16 PM Tuned

Out of the Box vs 3.16 & PowerTOP



| Savings (hh:mm) | |
|-----------------|------|
| SC_ON | 2:24 |
| SC_Off | 3:00 |

PowerTOP c-states Kernel 3.14.13-2

Screen on

Processor Idle State Report

| Package | 0 | Core 0 | CPU | 0 | CPU | 2 |
|------------|-------|--------------|-----------|--------|----------|--------|
| | | | C0 active | 0.0% | | 0.0% |
| | | | POLL | 0.0% | 0.0 ms | 0.0% |
| | | | C1E-HSW | 0.0% | 0.8 ms | 0.0% |
| C2 (pc2) | 98.6% | | C3-HSW | 0.1% | 4.8 ms | 0.0% |
| C3 (pc3) | 0.0% | C3 (cc3) | 0.1% | 2.3 ms | 0.0% | 2.3 ms |
| C6 (pc6) | 0.0% | C6 (cc6) | 0.0% | 2.0 ms | 0.0% | 2.8 ms |
| C7 (pc7) | 0.0% | C7 (cc7) | 98.9% | 0.0% | 1.3 ms | 0.0% |
| C8 (pc8) | 0.0% | | C8-HSW | 0.1% | 2.2 ms | 0.1% |
| C9 (pc9) | 0.0% | | C9-HSW | 0.7% | 6.0 ms | 1.4% |
| C10 (pc10) | 0.0% | | C10-HSW | 99.0% | 101.2 ms | 97.8% |
| | | Core 1 | CPU | 1 | CPU | 3 |
| | | | C0 active | 0.0% | | 0.0% |
| | | | POLL | 0.0% | 0.0 ms | 0.0% |
| | | | C1E-HSW | 0.0% | 0.2 ms | 0.0% |
| | | C3 (cc3) | C3-HSW | 0.1% | 3.3 ms | 0.0% |
| | | C6 (cc6) | C6-HSW | 0.0% | 1.1 ms | 0.4% |
| | | C7 (cc7) | C7s-HSW | 0.1% | 1.5 ms | 0.0% |
| | | | C8-HSW | 0.1% | 2.1 ms | 0.1% |
| | | | C9-HSW | 0.7% | 5.8 ms | 0.6% |
| | | | C10-HSW | 98.7% | 115.8 ms | 98.7% |
| | | GPU 26709088 | | | | |
| | | Powered On | 0.3% | | | |
| | | RC6 | 99.7% | | | |
| | | RC6p | 0.0% | | | |
| | | RC6pp | 0.0% | | | |

Screen on tuned

Processor Idle State Report

| Package | 0 | Core 0 | CPU | 0 | CPU | 2 |
|------------|-------|--------------|-----------|--------|----------|--------|
| | | | C0 active | 0.0% | | 0.0% |
| | | | POLL | 0.0% | 0.0 ms | 0.0% |
| | | | C1E-HSW | 0.0% | 0.1 ms | 0.0% |
| C2 (pc2) | 99.1% | | C3-HSW | 0.0% | 1.0 ms | 0.0% |
| C3 (pc3) | 0.0% | C3 (cc3) | 0.0% | 2.6 ms | 0.0% | 2.6 ms |
| C6 (pc6) | 0.0% | C6 (cc6) | 0.3% | 0.2% | 39.8 ms | 0.2% |
| C7 (pc7) | 0.0% | C7 (cc7) | 99.0% | 0.0% | 1.2 ms | 0.0% |
| C8 (pc8) | 0.0% | | C8-HSW | 0.0% | 2.3 ms | 0.2% |
| C9 (pc9) | 0.0% | | C9-HSW | 0.5% | 7.7 ms | 1.2% |
| C10 (pc10) | 0.0% | | C10-HSW | 99.2% | 153.6 ms | 98.0% |
| | | Core 1 | CPU | 1 | CPU | 3 |
| | | | C0 active | 0.0% | | 0.0% |
| | | | POLL | 0.0% | 0.0 ms | 0.0% |
| | | | C1E-HSW | 0.0% | 0.2 ms | 0.0% |
| | | C3 (cc3) | C3-HSW | 0.2% | 4.5 ms | 0.0% |
| | | C6 (cc6) | C6-HSW | 0.0% | 2.1 ms | 0.3% |
| | | C7 (cc7) | C7s-HSW | 0.0% | 1.2 ms | 0.0% |
| | | | C8-HSW | 0.2% | 2.1 ms | 0.1% |
| | | | C9-HSW | 0.8% | 6.4 ms | 0.6% |
| | | | C10-HSW | 98.7% | 125.0 ms | 98.7% |
| | | GPU 21159008 | | | | |
| | | Powered On | 0.4% | | | |
| | | RC6 | 99.6% | | | |
| | | RC6p | 0.0% | | | |
| | | RC6pp | 0.0% | | | |

PowerTOP c-states Kernel 3.16.0

Screen on C7 tuned

| Processor Idle State Report | | | | | | | | |
|-----------------------------|-------|----------|------------|---------|--------|----------|--------|----------|
| Package | 0 | Core 0 | CPU | 0 | CPU | 2 | | |
| | | | C0 active | 0.0% | | 0.0% | | |
| | | | POLL | 0.0% | 0.0 ms | 0.0% | 0.0 ms | |
| | | | C1E-HSW | 0.0% | 0.0 ms | 0.0% | 6.4 ms | |
| C2 (pc2) | 0.4% | | | | | | | |
| C3 (pc3) | 0.0% | C3 (cc3) | 0.0% | C3-HSW | 0.0% | 0.0 ms | 0.0% | 0.9 ms |
| C6 (pc6) | 0.0% | C6 (cc6) | 0.0% | C6-HSW | 0.0% | 0.0 ms | 0.0% | 0.0 ms |
| C7 (pc7) | 99.4% | C7 (cc7) | 99.9% | C7s-HSW | 0.0% | 0.0 ms | 0.0% | 2.5 ms |
| C8 (pc8) | 0.0% | | | C8-HSW | 0.0% | 1.9 ms | 0.0% | 1.6 ms |
| C9 (pc9) | 0.0% | | | C9-HSW | 0.2% | 23.4 ms | 0.3% | 19.7 ms |
| C10 (pc10) | 0.0% | | | C10-HSW | 99.8% | 609.5 ms | 99.6% | 362.5 ms |
| Core 1 | | | | | | | | |
| | | | CPU | 1 | CPU | 3 | | |
| | | | C0 active | 0.0% | | 0.0% | | |
| | | | POLL | 0.0% | 0.0 ms | 0.0% | 0.0 ms | |
| | | | C1E-HSW | 0.0% | 0.2 ms | 0.0% | 0.4 ms | |
| | | | | | | | | |
| | | C3 (cc3) | 0.0% | C3-HSW | 0.0% | 0.0 ms | 0.0% | 69.8 ms |
| | | C6 (cc6) | 0.0% | C6-HSW | 0.0% | 0.0 ms | 0.0% | 0.0 ms |
| | | C7 (cc7) | 99.9% | C7s-HSW | 0.0% | 2.0 ms | 0.0% | 0.7 ms |
| | | | | C8-HSW | 0.0% | 3.1 ms | 0.0% | 0.8 ms |
| | | | | C9-HSW | 0.0% | 6.5 ms | 0.0% | 5.9 ms |
| | | | | C10-HSW | 99.9% | 607.6 ms | 99.9% | 554.5 ms |
| GPU 0 | | | | | | | | |
| | | | Powered On | 0.2% | | | | |
| | | | RC6 | 99.8% | | | | |
| | | | RC6p | 0.0% | | | | |
| | | | RC6pp | 0.0% | | | | |

Linux command line parameters

i915.enable_psr=1

pcie_aspm=force

http://wireless.kernel.org/en/users/Documentation/ASPM#Enabling_ASPM_with_setpci

How is the software behaving?

Target: 1 units/s System: 133.3 wakeup/s CPU: 4.2% usage GPU: 1.8 ops/s GFX: 32.3 wakeups/s VFS: 0 ops/s

Overview of Software Power Consumers

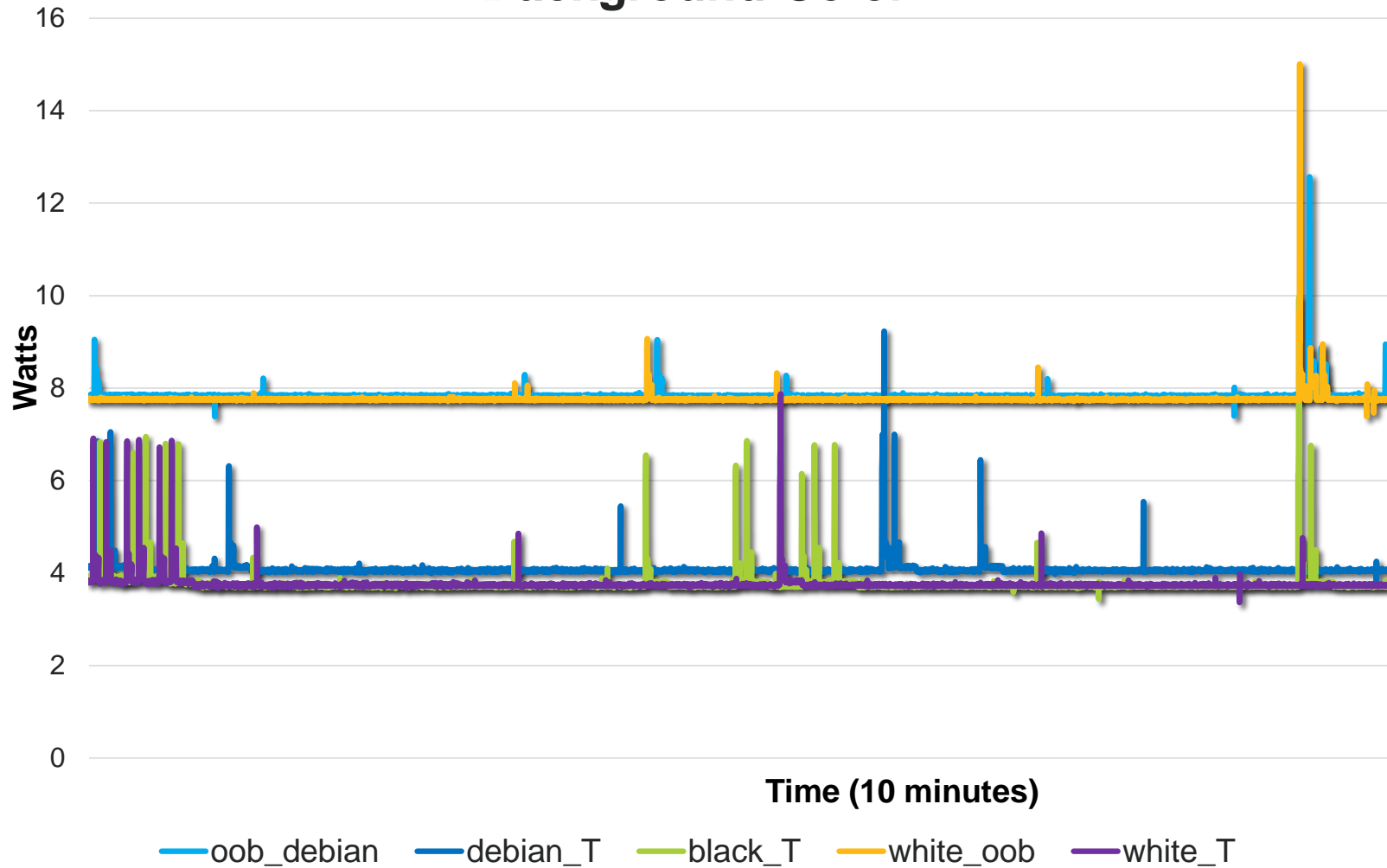
| Usage | Wakeup/s | GPU ops/s | Disk IO/s | GFX Wakeups/s | Category | Description |
|------------|----------|-----------|-----------|---------------|-----------|--|
| 13.9 ms/s | 46.8 | 0.0 | | 25.2 | Process | /usr/bin/gnome-screensaver --no-daemon |
| 147.5 us/s | 16.6 | | | | kWork | od_dbs_timer |
| 435.3 us/s | 16.0 | | | | Interrupt | [60] i915 |
| 532.6 us/s | 13.8 | | | 4.6 | Process | syndaemon -i 1.0 -t -K -R |
| 2.4 ms/s | 7.1 | 1.8 | | 2.2 | Process | compiz |
| 17.2 ms/s | 3.2 | | | | Process | /usr/bin/X -core :0 -auth /var/run/lightdm/root/:0 -nolisten tcp vt7 -novtswitch |
| 176.6 us/s | 8.0 | | | | Process | [rcu_sched] |
| 1.1 ms/s | 2.1 | | | | Process | /usr/bin/ibus-daemon --daemonize --xim |
| 490.4 us/s | 1.8 | | | | Timer | hrtimer_wakeup |
| 88.5 us/s | 1.8 | | | | Process | [irq/59-iwlwifi] |
| 221.4 us/s | 1.5 | | | | Timer | tick_sched_timer |
| 0.7 ms/s | 1.1 | | | | Process | /usr/lib/ibus/ibus-ui-gtk3 |
| 305.5 us/s | 1.2 | | | | Process | /usr/lib/x86_64-linux-gnu/indicator-power/indicator-power-service |

Common Devices


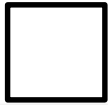


Background Impact

Background Color

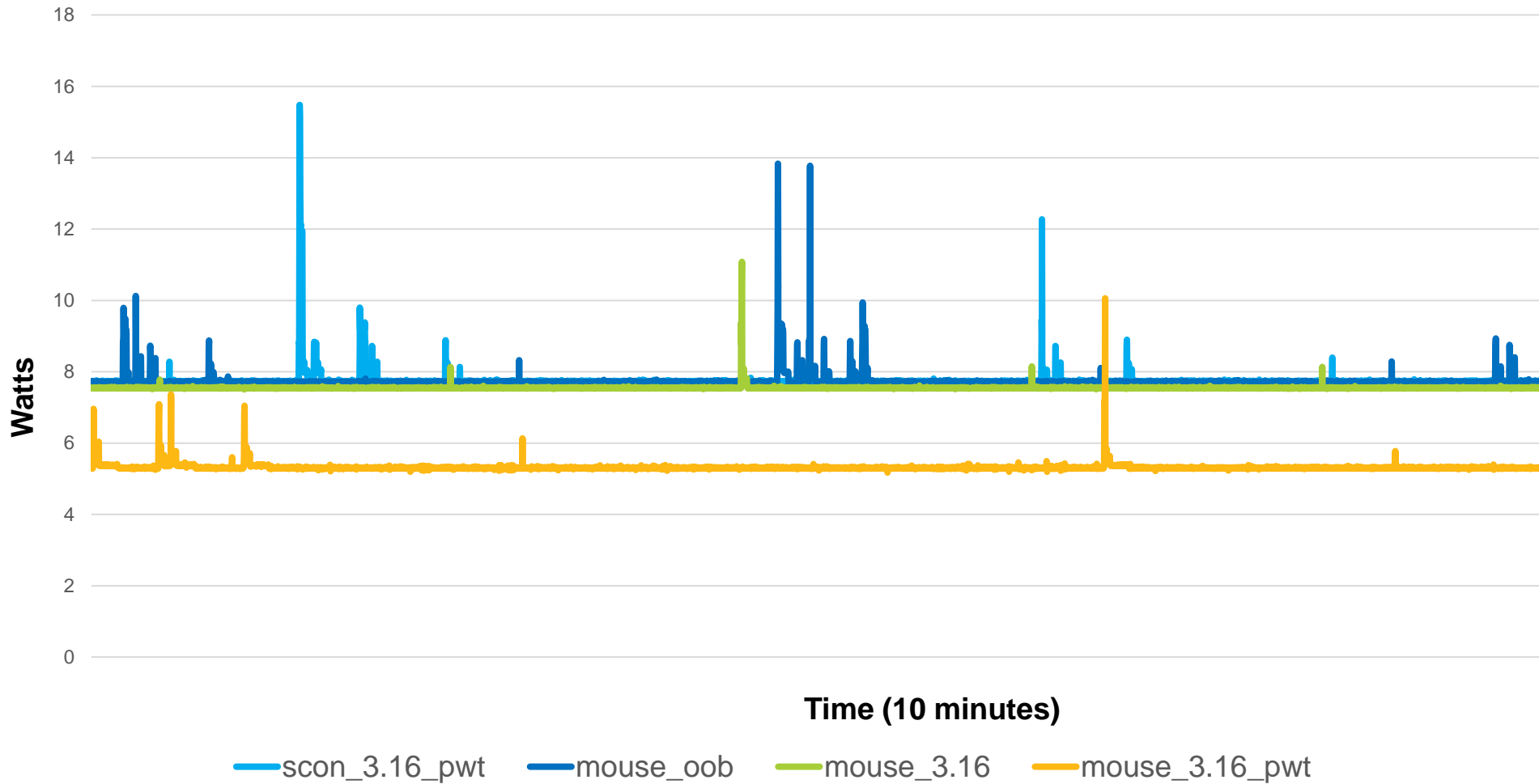


VS

| |  |  | Savings (hh:mm) |
|--|---|---|-----------------|
| | OOB | OOB | 00:04 |
| | OOB | Tuned | 4:35 |
| | Tuned | Tuned | 00:31 |

Device Consumption Mouse

Device Power Consumption



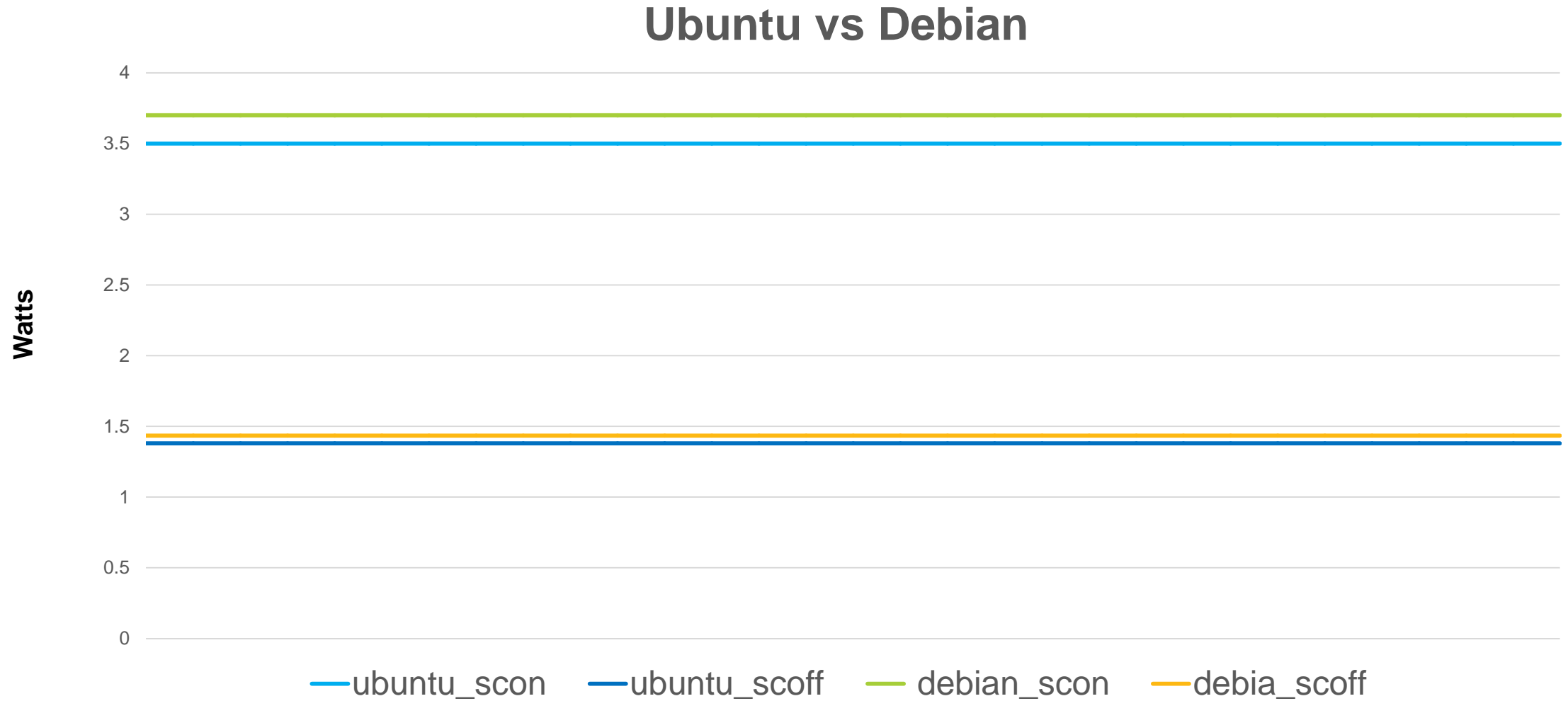
Savings (hh:mm)
Tuned 2:25

Other Distros



KEEP
CALM
IT'S
COMPETITION
TIME

Ubuntu vs Debian



Conclusion



Q&A

PowerTOP is an Open Source Project, Get Involved!!

<https://01.org/powertop/get-involved>

How to contribute to PowerTOP?

- 1- Join the mailing list
- 2- Get the code from the repo
- 3- Send your patches to the mailing list